Deutscher Tropentag, October 11-13, 2005, Hohenheim

"The Global Food & Product Chain—
Dynamics, Innovations, Conflicts, Strategies"

Importance of Soil Microbial Activity to Explain Legume-Rotation Effects on West African Soils

Beate Formowitz, Rainer Georg Joergensen, Andreas Buerkert

University of Kassel, Organic Crop Production and Agroecosystems Research in the Tropics and Subtropics, Germany

Abstract

Incubation experiments (20 days with 9 extraction times) with continuous (M) versus rotation (R) nutrient-poor soils from Fada-Kouaré (F), Burkina Faso and Koukombo (K), Togo were conducted to investigate the effects of rewetting on soil chemical (pH) and soil microbial properties (respiration, adenylates, AEC, ergosterol). Artificial rewetting of the dry soil thereby aimed at simulating the onset of the rainy season after a long period of drought stress. PH values remained largely unaffected by rewetting and were 6.1 for KM, 6.2 for KR, 6.3 for FM and 6.3 to 6.7 for FR with a wider range for the Fada soils. Respiration after rewetting reflected the common initial flush of CO_2-C (FM = 22.6 μg g*d^{-1}; FR = 37.1 μg g*d^{-1}; KM = 10.6 μg g*d^{-1}; KR = 13.9 μg g*d^{-1}) with a subsequent rapid decrease to values ranging from 0.6 to 8.1 μg g*d^{-1} CO_2-C. Ergosterol concentrations with a maximum of 0.67 μg g^{-1} (FR) soil and ATP concentrations with a maximum 0.69 μg g^{-1} soil were very low. Adenylate energy charge (AEC) indicated dominantly dormant cells (< 0.8) but during the second wetting cycle AEC > 0.8 were found in FM and FR indicating the effects of cell growth.

Low respiration levels, high AEC and increasing ATP concentrations indicated that the microbial cells were at a stationary 'metabolic alertness' to capture nutrients as a consequence of the rewetting-induced mineralisation. Partially retained activity in certain fractions of the cell's transcriptional resources might rather be due to growth mechanisms than survival strategies.

Overall the results showed significant site and system specific effects, thereby backing the expectation of specific microbial populations being part of the mechanisms of yield enhancing legume effects in cereal-legume rotations on West African soils.

Keywords: Adenylate energy charge, ATP, enhanced cereal production, microbial survival, respiration, rewetting

Contact Address: Beate Formowitz, University of Kassel, Organic Crop Production and Agroecosystems Research in the Tropics and Subtropics, Steinstr. 19, Witzenhausen, Germany, e-mail: formowitz@uni-kassel.de